
# UMTS — WHEN AND WHY IT WILL HAPPEN:

## Timetables and Forecasts

**A Shosteck Group White Paper**

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The Shosteck Group

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# TABLE OF CONTENTS

## CHAPTER 4: THE INFLUENCE OF EDGE



## CHAPTER 5: HANDSETS AND THEIR IMPACT



## CHAPTER 6: FORECASTING THE ADOPTION OF UMTS

# EXECUTIVE SUMMARY

## CHAPTER 1: AN OVERVIEW

This study analyzes the factors affecting the adoption of UMTS and forecasts its deployment. In so doing, it compiles, expands, and updates views that we have presented in our studies and strategic seminars since 1999.

Disappointing performance has plagued UMTS. However, this is common to all new technologies. In common with new technologies, UMTS will develop and flourish.

The evolution of UMTS is paralleling that of GSM and will continue to do so – bitter early disappointments, followed by maturation and success.

## CHAPTER 2: FACTORS DRIVING UMTS ADOPTION

This chapter discusses three factors that are driving UMTS adoption: (1) regulatory mandates, (2) greater capacity, and (3) reduced costs. We focus on the value of UMTS for providing low-cost voice capacity.

Regulators are giving some leeway to UMTS deployment schedules and becoming more open to infrastructure sharing. Nonetheless, they continue to mandate that most operators launch UMTS by years-end 2003 or 2004.

UMTS provides operators with new spectrum at 1900 and 2100 MHz. Legacy operators can use this to avoid the investment required to squeeze more capacity from crowded 900/1800 MHz GSM frequencies. In addition, the UMTS air-interface is more efficient than the GSM-GPRS and EDGE interfaces. This translates into lower capital and operating costs. These become more pronounced as traffic increases.

UMTS will be important for facilitating data services. However, into the near- to mid-term future, voice will produce most revenues. Because of this, the commercial advantage of UMTS lies not only in the enhanced/high-speed data services it enables, but also in the low-cost voice capacity that it provides.

The incremental capital and operating costs of GSM-GPRS and EDGE networks increase as the total traffic and the data proportion **increase**. For equivalent traffic, the incremental costs on UMTS networks **decrease**. This explains the value of UMTS.

As the total traffic and the ratio of data to voice expand, the cost of GSM-GPRS increases more rapidly than does that of EDGE. This is due to the greater efficiency of the EDGE radio interface, which, in theory, enables delivery of more packets over a fixed bandwidth. This translates into lower costs to deliver either voice or data. This cost advantage explains the rationale for adding EDGE to GSM-GPRS networks.

Nonetheless, over the mid- to long-terms, UMTS will provide the most cost advantage. However, UMTS requires a new network. Operators can only realize its cost-advantages after they have attracted enough subscribers (or more precisely revenues) to depreciate the investment. This will not happen before 2006-2008. Until then, the cost of UMTS depreciation will be allocated over too small a subscriber base to reduce it to that of GSM-GPRS and EDGE. This initial high cost of UMTS explains the reluctance of many operators to invest in it.

Beyond 2006-2008, the situation reverses. Increasing traffic and a greater proportion of data will raise the costs of GSM-GPRS and EDGE. At the same time, the costs of UMTS will continue to decline. Once the cost curves cross, operators that have deployed UMTS will enjoy a cost advantage over those who have not.

The crossing of the cost curves would explain Hutchison's market entry as a "pure" UMTS operator and its seemingly untenable tariff reductions in the U.K.

In March 2003, Hutchison launched Europe's first commercial UMTS networks in the U.K. and Italy. On June 5, Hutchison-U.K. slashed voice tariffs to 5p per minute or less. This represented as much as a 50 to 70 percent discount on the average price for mobile calls.

Hutchison has undoubtedly undertaken an analysis of UMTS similar to ours. If so, it would have reached a similar conclusion – over the mid- to long-terms, UMTS will prove profitable based on its lower costs for voice alone. Data would add yet more profits. Given this cost advantage, Hutchison could conclude that predatory pricing makes competitive sense. With such pricing it could possibly build a meaningful subscriber base before its legacy competitors respond.

## Chapter 3: Factors Impeding UMTS Adoption

This chapter examines two factors that have been thought of as impeding UMTS adoption – (1) financial constraints on the operators and (2) technology immaturity.

Most operators have slashed infrastructure expenses. Nonetheless, many hold strong cash positions and some continue to invest. Vodafone stands out. Its free cash flow more than doubled from £2,365 million in 2001-2002 to £5,171 million in 2002-2003. Over the same period, it raised its capital expenditures from £4,145 million to £5,289 million.

This reveals that some operators have the cash to build UMTS networks. It implies that other factors, in particular, immature technology, are more important in limiting investment.

NTT DoCoMo provides an example of the impact of technology maturity. DoCoMo launched UMTS in October 2001, deploying a Japanese variant (called FOMA or sometimes J-UMTS). The first handsets functioned poorly. In January 2003, DoCoMo launched improved handsets. Prior to then, it was drawing an average of 10,100 UMTS subscribers per month. Following, it drew an average of 76,600 per month.

DoCoMo launched UMTS early to give Japanese vendors experience with W-CDMA technology and, thereby, to benefit from their accelerated development of handsets. In April 2002, DoCoMo went a step further, investing $350 million in Sharp, NEC, Panasonic, Fujitsu, and Mitsubishi to support further development of handsets.

With earlier experience and DoCoMo's funding, Japanese vendors may bring improved UMTS handsets to Europe sooner than is commonly assumed. This will stimulate more rapid growth of UMTS subscribers than some may expect.

## Chapter 4: The Influence of EDGE

This chapter examines two questions – the extent to which deployment of EDGE might delay the launch of UMTS and the extent to which investment in EDGE might reduce investment in UMTS. We gathered information through a questionnaire survey of major equipment vendors and, to a lesser extent, European operators.

When asked directly, no vendor thought that the launch of EDGE would delay UMTS. Indeed, two saw it as enhancing UMTS adoption by stimulating data services and providing such services cost-effectively in low traffic areas.

Nor did respondents see EDGE deployment leading to reduced spending on UMTS. They viewed the technologies as providing different functionality under different circumstances, UMTS for high-traffic areas and EDGE for lower-traffic areas. Two vendors pointed out that more and more GSM base stations are being shipped as "EDGE ready" and would require only software to add EDGE functionality. They viewed adoption of EDGE as evolving "organically" through the continuous process of base station upgrades. This points to eventual EDGE adoption, regardless of circumstances.

Overall, the extent to which EDGE may or may not be deployed will not affect the deployment of UMTS. If anything, a robust adoption of EDGE could stimulate the data market and, thereby, accelerate deployment of UMTS.

## Chapter 5: Handsets and Their Impact

For end-users to adopt UMTS, handsets must be acceptable. Acceptability encompasses: (1) good performance, (2) a large number and variety of models, and (3) low, or acceptable, prices to end-users. Shortcomings with any of these will inhibit adoption.

Driven by competition among Japanese, Korean, European, and North American vendors, UMTS handsets will soon work reasonably well, and numerous models are quickly becoming available. We anticipate introduction of 16 to 20 models during 2003 and twice that during 2004. Improving handset functionality and the proliferation of choice will encourage UMTS adoption.

Initially, Japanese vendors will lead the market in terms of handset functionality and number of models. This will stem from their early experience with the DoCoMo network and the $350 million that DoCoMo has invested in them.

While current wholesale prices average from $450 to $500, Hutchison-U.K is subsidizing handsets to under $100. Hutchison has likely opened a permanent pricing war. Operators will offer UMTS handsets to heavy users at less than $100. Because of this, handset prices will not pose a critical barrier to UMTS adoption.

## Chapter 6: Forecasting the Adoption of UMTS

The question is not whether UMTS will be deployed, but how quickly. Because of Hutchison's tariff reductions of 50 percent or more, we foresee a more rapid take-up of UMTS than would otherwise be the case.

We forecast UMTS subscriber increases and handset sales from 2003 through 2007. We derived our forecasts from an analysis of the transition from analog to digital and estimates reported in our survey of major UMTS vendors.

By year-end 2003, we anticipate two to three million subscribers. During 2004, we expect an increase of five to12 million, to a total of seven to 15 million. During 2005, we foresee growth of 18-25 million, to a total of 25-40 million. During 2006, we expect gains of 30-40 million, to a total of 55-80 million. During 2007, we estimate 70 million new subscribers, bringing the total to 125-150 million.

Handset sales have two components – sales to new subscribers and replacements. During 2003, we assume nil replacement. Handset sales will equal the two-three million new subscribers. During 2004, we anticipate one million replacements. Added to five to 12 million new subscribers, handset sales will reach six to 13 million. During 2005, we assume five million replacements. Added to 18-25 million new subscribers, handset sales will total 23-30 million. Using similar assumptions, we estimate a total of 35-50 million handset sales during 2006 and 70-85 million during 2007.

# CHAPTER 1: AN OVERVIEW

## INTRODUCTION

This study analyzes the factors affecting the adoption of Universal Mobile Telephone Service (UMTS) and forecasts the timeframe for its deployment. In so doing, it compiles, expands, and updates views that we have presented in our studies and strategic seminars since 1999.

UMTS is the "Third Generation" (3G) technology to which GSM 900/1800 operators (primarily in Europe and outside of the Americas) will migrate as 1.9/2.1 GHz spectrum is assigned.[1] Our analysis focuses on Japan and, especially, Western Europe, where UMTS is first being deployed and which will be its major markets into the near- and mid-term future.[2]

Deployment of UMTS is affecting the industry all along the value chain. The impacts on infrastructure vendors, handset manufacturers, and operators are obvious. However, network integrators, chip producers, application and content providers, and vendors of billing software, among others, will likewise be affected.

Delayed launches, handset shortages, and disappointing performance have plagued UMTS. In May 2002, Norway's Telenor announced that UMTS was three years too early.[3] In August 2002, U.K. operators Vodafone and Orange postponed their UMTS launches from 2002 until 2003,[4] and more recently until 2004. In September 2002, following delayed launches of close to one year, Finland's Sonera delayed launch again.[5] In May 2003, the trade press reported that "Hutchison [the first U.K. operator to launch commercial UMTS] has experienced continuing problems with the performance quality of Nokia's [network]," problems that Nokia has acknowledged, but stated that it has corrected.[6] In June, Reuters opened a story with the lead sentence, "operators say no [UMTS] handset can yet deliver high-speed Internet, clear voice and video, and smooth handovers between base stations."[7]

These disappointing reports seemingly point to an impending technology disaster. However, they fail to acknowledge the process of technology evolution. In common with all new technologies, UMTS will mature. As it does, it will succeed – meeting virtually all of its early performance promises and, in some cases, exceeding them.[8]

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[1] Europeans may call 3G "W-CDMA." In almost all cases, they would be referring to the UMTS standard.

[2] At present, NTT DoCoMo deploys a variant of UMTS, usually called FOMA, but sometimes called J-UMTS. However, it will upgrade its network to the world standard (3GPP Release 4) during 2004. See: "DoCoMo Prepares for All-IP Network," *3G Mobile*, May 14, 2003, p. 2.

[3] "Telenor Says 3G Is Three Years Too Early," *3G Mobile*, May 29, 2002, p. 8.

[4] "More 3G Delays Announced in Europe," *RCR Wireless News*, August 12, 2002, p. 17. (Hereafter cited as *RCR*.)

[5] Press release, "Nokia Introduces the World's First Handset for WCDMA and GSM Networks," Nokia Mobile Phones, Helsinki, September 26, 2002.

[6] "Hutch's Nokia Network Woes?" *unstrung.com*, May 29, 2003. Nokia has acknowledged these difficulties (Rene Svendsen-Tune, SVP, Marketing & Sales, Nokia IP Mobility Networks, "Nokia Talks W-CDMA Update," webcast, Nokia Networks, Helsinki, Finland, June 3, 2003). In June, Hutchison opened the Nokia-supplied half of its UK network. See press release, "3 UK and Nokia Expand 3G Coverage to Northern UK," Nokia Networks, Helsinki, Finland, June 5, 2003.

[7] Lucas van Grinsven, "3G Handsets Unfit for Consumers, Operators Say," *Reuters*, June 12, 2003.

[8] "Notwithstanding Early Disappointments, UMTS Will Succeed," *The Shosteck Group Pulse*, The Shosteck Group, Wheaton, Maryland, November 2002, p. 1. (Hereafter cited as *Pulse*.)

## Why Early Technologies Fail[9]

All mobile technologies come to market later, deliver less, and cost more than vendors first promise.[10] We call this the "reality gap" between vendor assurance and early product performance. Three major factors contribute to this, although others do as well.[11]

**First** is the enthusiasm of the **R&D engineers** who develop the technology and provide the first laboratory demonstrations. In the case of radio frequency (RF) technologies, such demonstrations take little account of the interference, fading, and channel blocking of the real world.[12] Younger research engineers, in particular, have yet to experience the painful difficulties inherent in transforming laboratory demonstrations into commercial realities.

**Second** are the competitive pressures that play upon the **vendors**. These lead to what we call the principle of "the first lie." Once a salesperson of one vendor makes a false promise regarding the performance and/or availability of a new technology, salespersons of other vendors feel compelled to follow. Should they not, they believe that operators would perceive their company as lagging in the technology and preclude it as a supplier.

**Third** are the competitive pressures that play upon the **operators**. Marketing personnel may feel compelled to deploy new technologies to gain "first to market advantage," ignoring the challenges of maturation. The initial failures of Wireless Application Protocol (WAP)[13] and General Packet Radio Service (GPRS) serve as examples.

Some operators seem unable to learn from past failures. Often, this stems from "disconnects" between marketing, finances, and engineering within the operator organizations. When marketing plans are formed, engineers may not be consulted on the network and handset requirements needed to deliver specific applications. Financial personnel may not be consulted on when, if at all, they will support the needed network investment.

## The Early Failures of GSM

The reality gap is not unique to UMTS. The initial deployment of GSM during 1991-1992 reflected it as well. A review of *European Mobile Communications Report*, the trade publication of record at the time, reveals recurrent similarities between the uncertainties that faced GSM then and those that face UMTS now.

"Several operators have announced delays to supposedly Europe-wide opening of GSM services in July [1991]. The original opening date was agreed … long before … the difficulties of implementing [GSM] … became clear."[14] "Although 1 July [1991] has been long heralded as the

[9] This and the following section abridge and revise our earlier observations published in *Pulse*.

[10] This has been a central motif of the strategic seminars for senior industry executives that we have offered in the U.S. since 1985, at Oxford University (UK) from 1991 through 2002, and in Tuscany, Italy, since 2003.

[11] These may include whether the technology improves capacity, proves cost-efficient, in particular in terms of scalability, and enables backward compatibility with embedded technologies.

[12] For this reason, cellular handsets are uniquely different from other consumer electronics products.

[13] In mid-1998, we predicted the disappointment in WAP that would stem from "over-hyping" an immature technology. See: *The Implications and Risks of Wireless Application Protocol (WAP)*, 1998. For our most recent discussion, see: *WAP: The Value Chain Doesn't Stand Still*, May 2001.

[14] "Europe: GSM July 1991 Launch Summary," *European Mobile Communications Business and Technology Report* (today, Gloucester House, Churchfield Road, Walton-on-Thames, Surrey, UK), Nr. 52, May 1991, p. 4. (Hereafter cited as *EMC Report*.)

date for the start of commercial service … this date has now passed and none of the GSM operators are offering … service. The absence of terminals … [is] cited … for the delay."[15] "The question has increasingly been aired as to whether GSM will be at all marketable …"[16]

Notwithstanding this barrage of pessimism, GSM technology succeeded. As we analyze in the following pages, UMTS technology will as well.

## Organization of the Study

We have divided this study into six chapters. This first chapter discusses the doubt that surrounds UMTS. It argues that such doubt is misplaced in that all new technologies must mature. It introduces the concept of a "reality gap" between what vendors promise and what they deliver, and explains it. Finally, it draws a parallel between the pessimism over early GSM and that which now cloaks UMTS.

The second chapter examines the factors driving adoption of UMTS. It reviews regulatory mandates for UMTS deployment and analyzes the greater capacity and lower costs of UMTS for voice as well as data services. It adduces that Hutchison 3 has launched UMTS in Europe, in part, for its advantage in enabling low-cost voice service.

The third chapter analyzes financial constraints on the operators and failures of early handset performance. It documents that financial constraints are not universal and shows the stifling effect of poorly performing early technology. To illustrate the latter, it reviews the early disappointments of DoCoMo. It points to DoCoMo's assistance to Japanese vendors and suggests that this will enable them to introduce advanced handsets into Europe more rapidly than is commonly assumed.

The fourth chapter considers the role of EDGE. It examines the impact of EDGE on the timing of UMTS deployment and subsequent UMTS investment. Contrary to some assumptions, it suggests that, even though EDGE provides neither the capacity nor the throughput of UMTS, it **may encourage adoption of UMTS**, rather than slow it, by stimulating demand for data services.

The fifth chapter focuses on how well UMTS handsets will work, the number and variety of models, and pricing to end-users. It concludes that Japanese vendors are positioned to bring well-functioning handsets to market relatively quickly and, together with the Koreans, will assure a wide variety of models. It posits that by subsidizing handsets to sub-$100, Hutchison-U.K. has opened a price war that will force other operators to introduce such subsidies. These three factors together will further stimulate UMTS adoption.

The sixth chapter forecasts the adoption of UMTS. It derives the adoption curve that characterized the transition from analog to digital technology. It explains how the adoption of UMTS will differ from that of digital and modifies that curve accordingly. Finally, it estimates global UMTS subscribers and handset sales from 2003 through 2007.

[15] "Europe: GSM July 1991 Launch Summary," *EMC Report*, Nr. 53, June 1991, p. 4. (Note that the June date of publication is correct.)
[16] "GSM Marketability, *EMC Report*, Nr. 59, February 1992, p. 4.

In developing this study, we have relied on our earlier analyses of technology transitions, our historical record of handset sales by technology (as recorded in *Shosteck E-STATS*), information published by vendors, operators, and other industry participants, and trade press reports. In addition, we have interviewed sources in the vendor, operator, and related communities.

## Summary and Conclusions

This study analyzes the factors affecting the adoption of UMTS and forecasts its deployment.

Disappointing performance has plagued UMTS. However, this is common to all new technologies. In common with new technologies, UMTS will develop and flourish.

The evolution of UMTS is paralleling that of GSM and will continue to do so – bitter early disappointments, followed by maturation and success.

# CHAPTER 2: FACTORS DRIVING UMTS ADOPTION[17]

## INTRODUCTION

Four factors – some aspects of which may not be fully recognized – are driving and will drive, UMTS adoption. These are: (1) regulatory mandates, (2) greater network capacity, (3) reduced capital and operating costs, and, for end-users, (4) the availability of well-functioning, numerous, and low-priced handset models.

Other factors may influence adoption. One might add the feasibility of shared infrastructure, the desire of operators to recover licensing costs, the imperative for vendors to increase sales, and – on the negative side – local resistance to new towers. That said, we view the four factors above as primary.

We discuss the first three in this chapter. In particular, we focus on the value of UMTS for providing low-cost voice, as well as low-cost data, capacity. We posit that the reduced voice tariffs posted by Hutchison 3 in the U.K. reveal its recognition of these cost advantages. We conclude that the capacity and mid- to long-term cost advantages of UMTS will drive its deployment. We analyze the functionality, availability, and price of handsets in Chapter Five.

## REGULATORY MANDATES

The regulators of the EU member states, or their telecommunications ministries, issued 3G (UMTS) licenses from 2000 through 2002. As conditions, they required operators to cover stipulated percents of population by specified dates.[18] For example, at present, Sweden specifies 99 percent population coverage by the close of 2003.[19] Germany requires 25 percent coverage by the same date.[20]

Operators – collectively burdened with more than €100 billion in license fees – balked at the costs of constructing networks quickly. Their reluctance to construct increased as the immaturity of infrastructure, the unavailability of handsets, and the popular resistance to new cell towers became apparent. In response to operator concerns, most regulators allowed more time for construction. Others reduced their coverage requirements. Yet others authorized network sharing.

Sweden enacted legislation to empower the Posts and Telecom Authority (PTA) to authorize penalty-free rollout delays. In April 2003, the European Commission granted the request by T-Mobile and mmO2 to share UMTS networks in the U.K.[21] In July 2003, it approved network sharing in Germany, as well.[22]

While giving some leeway to the original deployment schedules, and becoming more open to infrastructure sharing, regulators nonetheless mandate that most operators launch UMTS by years-end 2003 or 2004.

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[17] We wish to express our thanks to Geoffrey Varrall, principal, RTT Programmes, Ltd., Twickenham, U.K. and Satyajit Doctor, President, Award Solutions, Richardson, Texas, for their technical reviews of earlier drafts of this chapter.

[18] Personal communication, Christer E. Hammarlund, Principal Administrator, European Commission, Information Society Directorate-General, Brussels, Belgium, June 4, 2003.

[19] Jan Strupczewski, "Tele2, TeliaSonera Seek Delay in Swedish 3G Rollout," *Reuters*, March 31, 2003.

[20] "Licensing News," *Global Mobile*, May 21, 2003, p. 5.

[21] "Mobile Operators to Share 3G Networks," *Reuters*, April 30, 2003.

[22] "EC Oks German 3G Net Sharing," *unstrung.com*, July 16, 2003.

To recover these mandated infrastructure investments, most operators will load those networks quickly. This, together with competitive pressures, is stimulating/will stimulate UMTS adoption.

## The Greater Capacity and Lower Costs of UMTS

UMTS provides legacy GSM operators with new spectrum at 1900 and 2100 MHz. In dense urban areas, operators can use this to avoid what otherwise would be the escalating investment required to squeeze more capacity from crowded 900/1800 MHz GSM frequencies.[23] Such investment would stem from acquiring new cell sites, adding base stations, implementing cell splitting, enhancing overlay-underlay, installing robust base station filters, placing improved amplifiers, and/or deploying "smart antennas."[24]

As importantly, the UMTS air-interface is more efficient than are the GSM-GPRS and EDGE interfaces, in particular, for mixed voice and data. This translates into greater traffic capacity per MHz of spectrum and, correspondingly lower operating costs. These lower costs become more pronounced as traffic increases. As we suggest below, such cost advantages will likely become apparent in approximately 2006-2008.

The precise cost savings will depend on a myriad of factors. These will include total traffic, the voice-data traffic mix, the ratio of high- to low-bandwidth data, latency requirements, the characteristics of peak-hour traffic, and the amount of spectrum used (5 + 5 MHz or 10 + 10 MHz), among others.

Yet, the industry has seemingly ignored the capacity gains and cost savings that UMTS allows and, instead, focused on the data services that it enables. As recent examples, in a webcast, Nokia lauded the "full set of [data] features" that UMTS will enable.[25] In a press release announcing the launch of UMTS in Austria, Siemens emphasized "video telephony … multimedia services … [and] live video feeds."[26] In describing a study of the U.K. mobile market authored by The Work Foundation, a trade article began with the statement that operators "are pinning their hopes on 3G, which offers new services like video calls, and football highlights."[27] None of these examples noted the greater capacity and/or cost efficiencies that UMTS provides, let alone with regard to voice.

Vodafone has been a notable exception. On May 2, it opened its UMTS network in Ireland for pre-commercial service. In the first paragraph of its press release, it stated that "3G service … provides superior data speeds of up to 144 kbps … and **enhanced voice capacity** (emphasis added)."[28]

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[23] The phrase "crowded spectrum" should be placed in context. In general, there is no shortage of GSM 900/1800 MHz spectrum in Europe. Nonetheless, many operators face peak-capacity constraints in dense urban areas. Such constraints may be due to limited spectrum assignments made by national regulators and/or to previous reluctance by the operators to invest in GSM. Both of these factors will influence the immediate advantage of UMTS for capacity relief, as will the regulatory mandates for launching UMTS.

[24] AMR handsets will provide capacity relief as they enter the market. However, over the short- to mid-terms, this relief will be limited compared to the greater capacity requirements GSM networks will need in major urban centers.

[25] Rene Svendsen-Tune, SVP, Marketing & Sales, Nokia IP Mobility Networks, analyst webcast, Nokia Networks, Helsinki, Finland, June 3, 2003.

[26] Press release, "3G/UMTS Launches in Austria: Siemens Supplying Mobile Networks and Phones," Siemens AG, Munich, Germany, May 9, 2003.

[27] "British Consumers Threaten 3G UK Success," *3g.co.uk*, April 2, 2003.

[28] Press release, "Vodafone Launch 3G," Vodafone, Ltd., Newbury, Berkshire, UK, May 2, 2003.

## Refocusing on Voice

Abstractly, the industry recognizes the capacity and cost advantages for voice that UMTS provides. Yet, as we have illustrated, few are talking of those advantages – and, by inference, paying full attention to them. When placed in the perspective of industry revenues, this lack of attention is remarkable. **Voice generates most revenue.**[29]

In Western Europe, mmO2-Germany has led in data revenues. During 2002, it reported 19.7 percent of revenue generated by data. Vodafone-Portugal has lagged. During 2002, it reported 6.9 percent.[30] These proportions mean that voice still generates 80.3 to 93.1 percent of operator income.

Few, if any, expect a drastic change within the near future. In January 2003, Vodafone, the world's largest mobile operator, set out to raise group-wide data revenues from an average 13.9 percent during 2002 to 20 percent during 2004.[31] In May, Orange-U.K. announced its intention to increase data revenues from 13 percent during Q1-2003 to 25 percent during 2005.[32] In June, Nokia expected that data would produce 30 percent of operator revenues by 2007.[33]

Because UMTS increases capacity, it will become increasingly important, indeed essential, for facilitating expanded data services. However, into the near- to mid-terms, if not beyond, voice will continue to produce most revenues. On this account, **the strategic advantage of UMTS may lie as much in the low-cost voice capacity that it provides as in the high-speed data services that it enables**. We examine the costs of delivering voice over GSM-GPRS and EDGE compared to UMTS in the following two sections.

## The Cost of Voice over GSM-GPRS and EDGE

As we observed earlier, myriad factors affect costs. This precludes quantifying them precisely. Nonetheless, we can develop **conceptual graphs** that compare the **relative costs of delivering voice for each of the three technologies**.

**Figure 2.1** depicts the theoretical costs for carrying voice minutes over GSM-GPRS and EDGE networks as the total traffic and the data proportion increase. The total traffic and traffic mix are hypothetical, as are the cost curves, but are based on original assumptions of the UMTS Forum.[34] Those assumptions have been revised to account for the negative market conditions and the more than one-year delay in UMTS deployment that the industry has experienced since 2001.

The horizontal (X) axis depicts the combined increases in total traffic and the data proportion of traffic over time. The vertical (Y) axis depicts the relative network costs – capital and operating – for delivering a **voice minute**. We benchmark these against the costs of a voice minute over a

[29] At present, data margins – most of which are generated by low bandwidth SMS – far exceed voice margins. As operators deploy UMTS, they will face the challenge of generating high margins from inherently expensive high-bandwidth transmissions.

[30] "Data Revenues for Selected Operators, 4Q-02," *3G Mobile*, March 19, 2003, pp. 6-7.

[31] Maija Pesola, "Vodafone Customer Revenues Continue to Rise," *Financial Times*, January 27, 2003.

[32] David Pringle, "Orange Moves to Train Users to Better Use Current Phones," *The Wall Street Journal*, May 9, 2003.

[33] "Nokia's Mobile-Network Sales Expected to Drop 15% in 2003," *The Wall Street Journal*, June 11, 2003.

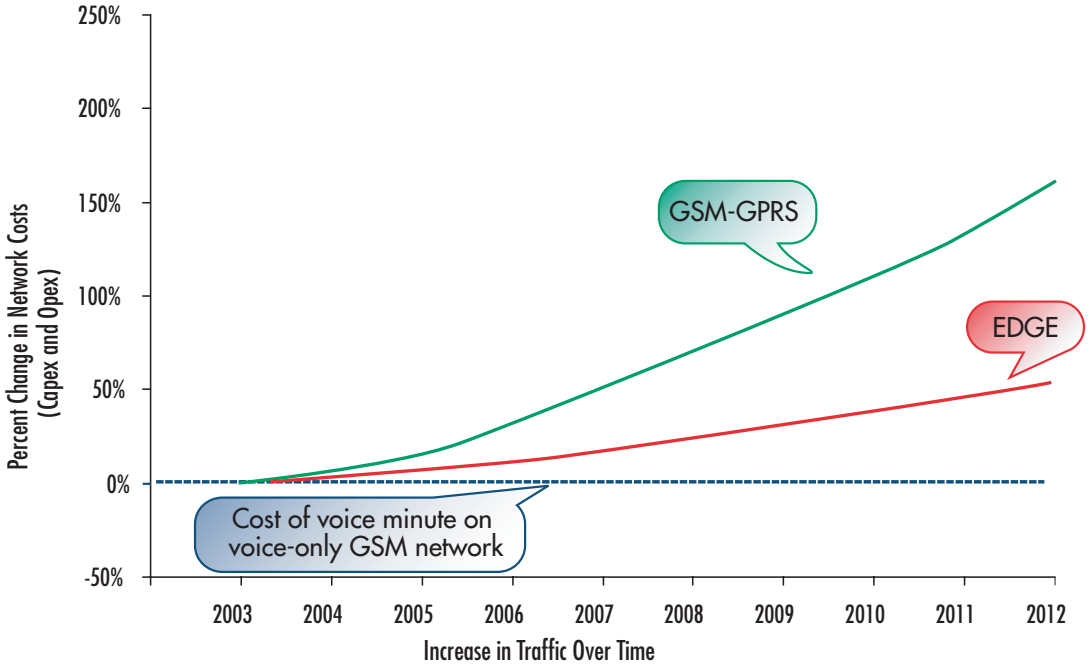
[34] See in particular, *The UMTS Third Generation Market Study Update* (UMTS Forum Report 17), UMTS Forum, London, August 2001 (www.umts-forum.org…) and "The Complete WCDMA Solution: Comprehensive Evolution from GSM," InterDigital Communications Corporation©, King of Prussia, Pennsylvania, 2003.

voice-only GSM network with stable traffic. This is the zero-line that parallels the x-axis. It enables us to evaluate the relative network costs of voice over GSM-GPRS and EDGE, and later over UMTS, as traffic increases. To reiterate, this is a conceptual presentation. The relationship of costs to years is approximate. The percent differences are arbitrary.

The two curves depict the relative costs of delivering voice minutes over GSM-GPRS and EDGE networks as the traffic and mix of data to voice increase over time.

FIGURE 2.1

**RELATIVE COST PER VOICE MINUTE OF GSM-GPRS AND EDGE NETWORKS AS TRAFFIC INCREASES**




Source: The Shosteck Group. Conceptual estimates based on "The UMTS Third Generation Market Study Update" - Report 17, UMTS Forum, London, UK, August 2001 (www.umts-forum.org) and "The Complete WCDMA Solution: Comprehensive Evolution from GSM" InterDigital Communications Corporation©, King of Prussia,Pennsylvania, 2003. The increase in traffic over time assumes increases in total traffic and the proportion of data traffic. The relationships of costs to years is approximate and arbitrary. Values as of year-end.

They show the cost of GSM-GPRS escalating more rapidly. This is because GPRS, while providing packet transport, does not add capacity to the GSM radio interface. As a consequence, when data traffic is sent over GSM-GPRS, it occupies what otherwise would be a voice time-slot. Accordingly, as traffic increases – whether voice or data – operators must add proportionately more radio channels. Under crowded traffic conditions, this becomes more expensive.

In theory, the cost for delivering voice over EDGE does not increase as rapidly. This is due to the greater efficiency of the EDGE radio interface, which enables operators to deliver more packets over a given bandwidth. As a consequence, for a given increase in data traffic, operators need not expand radio capacity as much. This translates into correspondingly lower costs to deliver either voice or data.

This apparent cost advantage explains the rationale for adding EDGE to GSM-GPRS networks. However, as we show below, over the mid- to long-terms, UMTS, not EDGE, will provide the greater cost advantage.

To reiterate, the above are conceptual curves. They represent the added costs that would occur if operators accommodated increasing traffic by continuing to invest in GSM-GPRS and EDGE.

We speculate that, in practice, European operators are unlikely to allow network traffic, and associated network costs, to reach such levels. We speculate that , instead, they will invest in UMTS or, over the short-term, discourage excessive network traffic by maintaining tariffs – or in the case of high-bandwidth data – possibly increasing them.

## The Cost of Voice over UMTS[35]

To repeat, over the mid- to long-terms, the advantage of UMTS stems from its greater capacity and lower network costs – for voice and data – compared to GSM-GPRS and EDGE.[36]

For example, Alcatel sees the generic **cost** of a UMTS base station (Node B) as already virtually the same as that of a GSM-GPRS base station. Yet, over the "long run" and depending on traffic mix, the **capacity** of the Node B will approach as much as eight times that of conventional GSM-GPRS.[37] Because of this – and in contrast to GSM-GPRS and EDGE – the incremental costs on UMTS networks **decrease** as the **total traffic** and **proportion of data traffic** increase. We discuss this below.

**Figure 2.2** overlays the cost of delivering voice minutes over a UMTS network onto the previous figure.[38] This shows an extraordinary high cost from 2003, the first European deployment of UMTS, into approximately 2006-2008. The high cost will be due to the slow initial subscriber adoption of UMTS. Because of this, the costs of network depreciation will be allocated over too small a subscriber base to reduce them to those of GSM-GPRS and EDGE.[39]

[35] For purposes of this analysis, we assume that networks are at capacity. As such, they would require additional infrastructure spending to support additional traffic. Another school of thought posits that once capacity is in place, additional traffic is "free" until the network reaches a new capacity limit. Discussion of these two perspectives is beyond the scope of the present study.

[36] Network costs include capital and operating expenses. They exclude payments for licenses, if any.

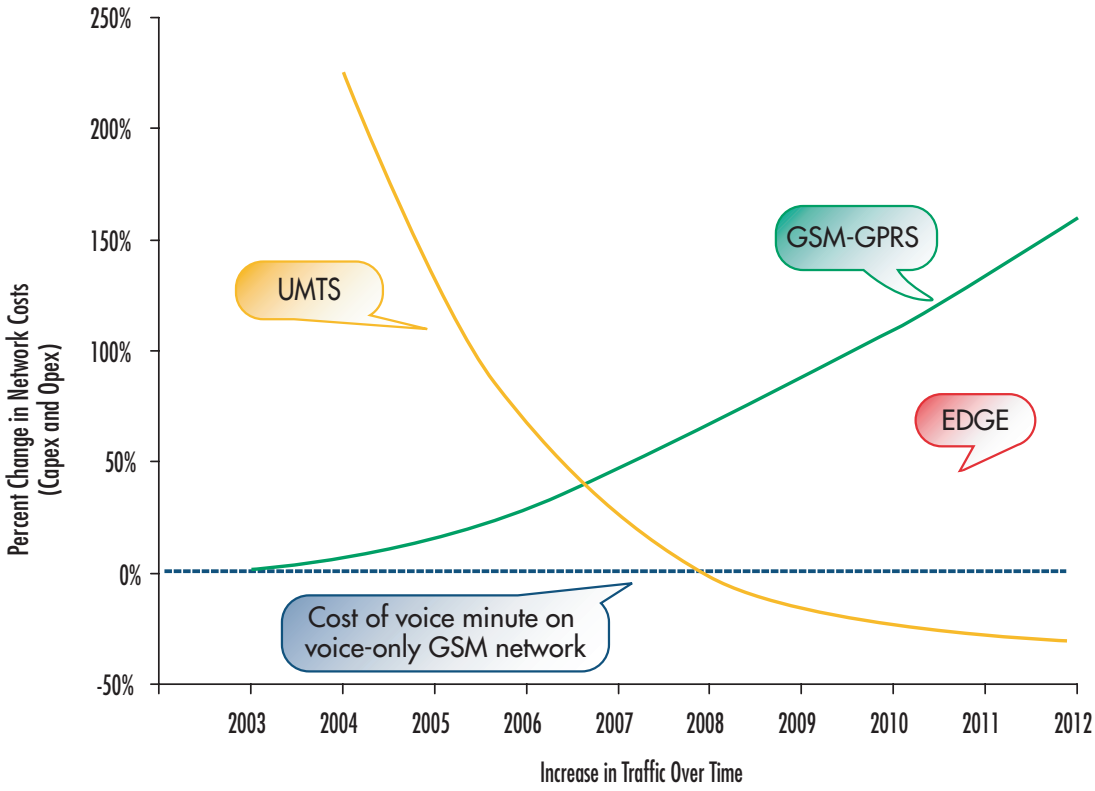
[37] Personal communication, Jean-Louis Hurel, Marketing Director, Mobile Networks, Alcatel, Paris, France, July 17, 2003.

[38] This depicts the cost-benefits of FDD. TDD would not have a meaningful effect on the market until after FDD is widely deployed and data traffic becomes substantially more significant.

[39] For an extensive discussion of UMTS costs, see "Chapter Five: Applying the Model to UMTS Services," *AMPU (Average Margin per User) – Not ARPU (Average Revenue per User): A Better Metric for the Wireless Industry*, The Shosteck Group, Wheaton, Maryland, May 2003, pp.44-54.

FIGURE 2.2

**RELATIVE COST PER VOICE MINUTE OF GSM-GPRS, EDGE, AND UMTS NETWORKS AS TRAFFIC INCREASES**




Source: The Shosteck Group. Conceptual estimates based on "The UMTS Third Generation Market Study Update" - Report 17, UMTS Forum, London, UK, August 2001 (www.umts-forum.org) and "The Complete WCDMA Solution: Comprehensive Evolution from GSM" InterDigital Communications Corporation©, King of Prussia,Pennsylvania, 2003. The increase in traffic over time assumes increases in total traffic and the proportion of data traffic. The relationships of costs to years is approximate and arbitrary. Values as of year-end.

These high network costs during the early years of UMTS operation explain the reluctance of many operators to invest in it.

Beyond 2006-2008, the situation reverses. Both increasing traffic and a greater proportion of data will inexorably raise the theoretical per-minute costs of EDGE and, especially, those of GSM-GPRS. At the same time, the real costs of UMTS will continue to decline. **Once the cost curves cross, the operators that have deployed UMTS will enjoy an increasing cost advantage over those who have not.**

As we have speculated, operators will, in practice, prevent the cost curves for GSM-GPRS and EDGE from increasing. Nonetheless, as UMTS networks load, the costs for UMTS will continue to decline. This means that the curves will still cross – and UMTS will still become less expensive.

## Adducing the Hutchison Strategy

We focus on Hutchison because, as of this writing (August 2003), it is the only operator to have launched commercial UMTS service in the most populous Western European countries.[40] It is a "green field" operator, with no GSM-GPRS network of its own. To supplement its incomplete UMTS coverage, it has reached roaming agreements to use mmO2's GSM-GPRS networks.

We have no direct knowledge of Hutchison's marketing strategy. However, as we posit below, the crossing of the cost curves would explain the seemingly untenable tariff reductions which Hutchison-U.K. has introduced.

In March 2003, Hutchison launched Europe's first commercial UMTS networks in the U.K. and Italy. Notwithstanding similar populations,[41] adoption in the U.K. lagged that in Italy. By March 20, Hutchison had attracted 50,000 subscribers in Italy compared to 10,000 in the U.K.[42]

At first, Hutchison-U.K. lowered handset prices to draw more subscribers. Initially, it priced the less expensive of the two available UMTS models at £399 ($640),[43] less a 50 percent introductory discount (£199).[44] By early April, the price had dropped to as low as £125.[45] That did little to draw more subscribers. By late May, subscriber counts in Italy and the U.K. were 90,000 and 25,000, respectively.[46]

On June 5, Hutchison-U.K. slashed voice tariffs, dropping charges to 5p per minute or less.[47] Citing industry analysts, the Financial Times characterized the cuts as "a near 70 percent discount on the current [industry] average per-minute price for mobile calls,"[48] although we surmise that 50 percent is more correct.

We find it difficult to believe that Hutchison did not develop a cost analysis similar to ours. Assuming so, it would have reached a similar conclusion – discounting data applications, over the mid- to long-terms, UMTS would prove profitable based on its lower cost to deliver voice, alone.

Profitability would be yet greater with data traffic. That would be stimulated by increasingly functional handsets, as well as the advent of PC cards to facilitate high-speed laptop transmissions. Western as well as Japanese vendors are introducing these cards. As early as November 2002, Lucent completed testing a UMTS PC card, which it co-developed with Option Wireless Technology, a Belgian company.[49] Given these cost advantages, Hutchison could perceive that a predatory pricing strategy for voice services makes competitive sense.

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[40] The four largest Western European countries are: Italy, France and the U.K with populations of 58 to 60 million, and Germany with a population of 83 million. Fifth-ranked Spain has a population of 40 million.

[41] As of 2001, the population of the U.K. stood at 59.6 million and that of Italy stood at 57.7 million. (Table 1327, "Population by Country: 1990 to 2010," *Statistical Abstract of the United States: 2001, 121st Edition*, GPO, Washington, DC, 2001, pp. 832-833.)

[42] "Hutchison 3 Phones in 1,000 U.K. Shops by Weekend," *Reuters*, April 10, 2003.

[43] Converted to US$ at £1.00 = $1.60. Conversion values rounded to nearest $10.

[44] Alan Cane, "Hutchison Launches 3G to Little Fanfare," *Financial Times*, March 3, 2003.

[45] Robert Budden, "Hutchison 3G Cuts Prices," *Financial Times*, April 9, 2003.

[46] "Hutch Nets 115,000 3G Subs," *Global Mobile*, June 4, 2003, p. 6.

[47] "Hutchison's U.K. Cellphone Start-up in Price Assault," *Reuters*, June 5, 2003.

[48] Robert Budden and Chris Nuttall, "Hutchison Slashes 3G Voice Tariffs in UK," *Financial Times*, June 5, 2003.

[49] Press release, "Lucent Technologies and Option Demonstrate Successful Data Calls Using Jointly Developed Wireless Modem Cards for 3G UMTS Networks," Lucent Technologies, Murray Hill, New Jersey; Option Wireless Technology, Leuven, Belgium; November 18, 2002.

Based on what we surmise is Hutchison's strategy, attracting voice subscribers and use is essential. As long as UMTS handsets provide voice, they enable Hutchison to gain as much as a one-year market advantage over competitors, such as Vodafone, who do not plan full launches of UMTS until early 2004.[50]

Hutchison's strategy may or may not prove commercially successful. Nonetheless, it marks a fundamental shift in how European operators will view the cost and pricing of mobile services. In the words of one analyst, it "will change the U.K. market forever."[51] That change will accelerate the adoption of UMTS.

## Summary and Conclusions

This chapter discusses three factors that are driving UMTS adoption: (1) regulatory mandates, (2) greater capacity, and (3) reduced costs. We focus on the value of UMTS for providing low-cost voice capacity.

Regulators are giving some leeway to UMTS deployment schedules and becoming more open to infrastructure sharing. Nonetheless, they continue to mandate that most operators launch UMTS by years-end 2003 or 2004.

UMTS provides operators with new spectrum at 1900 and 2100 MHz. Legacy operators can use this to avoid the investment required to squeeze more capacity from crowded 900/1800 MHz GSM frequencies. In addition, the UMTS air-interface is more efficient than the GSM-GPRS and EDGE interfaces. This translates into lower capital and operating costs. These become more pronounced as traffic increases.

UMTS will be important for facilitating data services. However, into the near- to mid-term future, voice will produce most revenues. Because of this, the commercial advantage of UMTS lies not only in the enhanced/high-speed data services it enables, but also in the low-cost voice capacity that it provides.

The incremental capital and operating costs of GSM-GPRS and EDGE networks **increase** as the total traffic and the data proportion increase. For equivalent traffic, the incremental costs on UMTS networks **decrease**. This explains the value of UMTS.

As the total traffic and the ratio of data to voice expand, the cost of GSM-GPRS increases more rapidly than does that of EDGE. This is due to the greater efficiency of the EDGE radio interface, which, in theory, enables delivery of more packets over a fixed bandwidth. This translates into lower costs to deliver either voice or data. This cost advantage explains the rationale for adding EDGE to GSM-GPRS networks.

Nonetheless, over the mid- to long-terms, UMTS will provide the most cost advantage. However, UMTS requires a new network. Operators can only realize its cost-advantages after they have attracted enough subscribers (or more precisely revenues) to depreciate the investment. This will

[50] Anne Morris, Qualcomm, "Vodafone talk up Drive Towards UMTS," *Total Telecom*, June 11, 2003.
[51] Robert Budden and Chris Nuttall, "Hutchison Slashes 3G Voice Tariffs in UK," *Financial Times*, June 5, 2003.

not happen before 2006-2008. Until then, the cost of UMTS depreciation will be allocated over too small a subscriber base to reduce it to that of GSM-GPRS and EDGE. This initial high cost of UMTS explains the reluctance of many operators to invest in it.

Beyond 2006-2008, the situation reverses. Increasing traffic and a greater proportion of data will raise the costs of GSM-GPRS and EDGE. At the same time, the costs of UMTS will continue to decline. Once the cost curves cross, operators that have deployed UMTS will enjoy a cost advantage over those who have not.

The crossing of the cost curves would explain Hutchison's market entry as a "pure" UMTS operator and its seemingly untenable tariff reductions in the U.K.

In March 2003, Hutchison launched Europe's first commercial UMTS networks in the U.K. and Italy. On June 5, Hutchison-U.K. slashed voice tariffs to 5p per minute or less. This represented as much as a 50 to 70 percent discount on the average price for mobile calls.

Hutchison has undoubtedly undertaken an analysis of UMTS similar to ours. If so, it would have reached a similar conclusion – over the mid- to long-terms, UMTS will prove profitable based on its lower costs for voice alone. Data would add yet more profits. Given this cost advantage, Hutchison could conclude that predatory pricing makes competitive sense. With such pricing it could possibly build a meaningful subscriber base before its legacy competitors respond.

# CHAPTER 3: FACTORS IMPEDING UMTS ADOPTION

## INTRODUCTION

Our previous chapter discussed three factors that are driving UMTS adoption. This chapter examines two that are impeding it: (1) financial constraints of the operators, and (2) technology immaturity.

A widely proclaimed weakening in the financial condition of the operators has been viewed as a major constraint and seems most discussed. However, as we conclude below, technology immaturity, in particular, the early "over promise" by manufacturers concerning handset performance and availability, may be more important.

One might also add limited coverage. However, for two reasons, we consider this less significant. **First**, if a technology performs poorly, subscriber acceptance will be constrained regardless of coverage. **Second**, Hutchison – Europe's first and only "green field" UMTS operator – is providing access to GSM-GPRS networks through roaming arrangements with other operators in areas where it has yet to deploy. As established operators launch UMTS, they will use their own GSM-GPRS networks to support data services beyond UMTS coverage areas. This will enable many of the data services facilitated by UMTS, albeit at slower data rates.

## FINANCIAL CONSTRAINTS OF THE OPERATORS

The "telecommunications bubble" burst during late 2000. Driven by excessive bids for 3G licenses and acquisitions, the debts of wireless operators grew exponentially. By early 2002, Deutsche Telekom and France Telecom, then the behemoths of Europe, had each amassed debts, or debt obligations, in excess of €60 billion.[52]

In the name of "stronger balance sheets," landline and wireless operators closed their wallets to all but the minimum of infrastructure investment. As a consequence, the revenues of infrastructure vendors collapsed. In the two years from 2000 to 2002, Lucent's revenues fell from $33.8 billion to $10.8 billion, a drop of 68 percent. Nortel's fell from $30.3 billion to $10.6 billion, a drop of 65 percent. Ericsson's fell from $29.7 billion to $15.2 billion, a drop of 49 percent.[53]

Many have cited these declines as the reasons for operators delaying UMTS. Operators aren't spending, regardless of technology. To some extent this is true. Yet, contrary to popular belief, the financial statements of some European operators belie weak cash positions as the reason for investment delays. We use as examples, TeliaSonera, one of the smaller European operators, and Vodafone, the largest.

For 2002, TeliaSonera (newly formed by a merger of Sweden's Telia and Finland's Sonera) reported a net loss of -€3.6 billion. For 2001 its predecessor companies reported net income of €0.2 billion. During 2002, TeliaSonera reduced its capital expenditures to €1.2 billion, 47 percent less than the €2.3 billion spent by its predecessors during 2001. However, these seemingly dismal values

[52] Craig Karmin, "Despite Gains, Concerns about Accounting Methods in Telecommunications Sector Linger in Europe," *The Wall Street Journal*, February 26, 2002, p. C12.

[53] Company financial statements and derivations by The Shosteck Group. For full analysis, see: "The Collapse and Recovery of Telecom Sales"; *2003 "Oxford in Tuscany" Program: Market and Business Profit Opportunities to 2007*; The Shosteck Group, Green Park Resort, Tirennia, Italy, June 22-27, 2003.

masked a stronger balance sheet. TeliaSonera also reported free cash flow of €1.0 billion during 2002 compared to a cash loss of -€0.8 billion by its predecessors during 2001. More telling of financial strength, the company doubled its 2002 dividend to €0.44 per share from the €0.22 per share that its predecessors paid for 2001.[54]

Vodafone – by far the world's largest wireless operator[55] – reported net losses for years ended March 2003 and March 2002 of -£9,819 million and -£16,155 million, respectively. However, virtually all of these losses were amortization of goodwill, a non-cash accounting item. Free cash flow more than doubled from £2,365 million to £5,171 million. In common with TeliaSonera, Vodafone increased its dividend, from 1.47p to 1.69p per share, a gain of 15.0 percent.[56] Unlike TeliaSonera, Vodafone also **increased** its capital expenditures ("tangible fixed assets") from £4,145 million during 2001-2002 to £5,289 million during 2002-2003,[57] a gain of 27.6 percent.

These financial reports show that not all European operators are starved for the cash needed to build UMTS networks. Both TeliaSonera and Vodafone appear able to finance such investments. Indeed, during 2002-2003, Vodafone did so. J-PHONE, Vodafone's Japanese subsidiary,[58] launched 3G services on December 20, 2002, deploying the European UMTS standard.[59] This was the second commercial network in the world and undoubtedly launched as a direct response to DoCoMo's J-UMTS. Vodafone plans to have commercial UMTS services "available to [European] customers" by March 2004. Vodafone cites "[t]he [limited] availability of suitable handsets," not finances, as the barrier to earlier UMTS deployment.[60]

The above suggest that the "crisis" in operator liquidity and infrastructure investment is more perceived than real. For some operators, finance is not a deterrent to constructing networks. Indeed, for most it may no longer be an issue. The financial press is reporting that European operators are now "throwing off gobs of cash."[61] Other factors, in particular the immaturity of UMTS technology, may be more important. We discuss this below and note how it is changing.

[54] *TeliaSonera Annual Report 2002*, TeliaSonera, Farsta, Sweden, 2003, p. 3 and derivations by The Shosteck Group.

[55] At year-end 2002, the Vodafone Group and companies in which Vodafone held interests, served 296 million wireless customers. This amounted to 26.0 percent of a global total of about 1,135 million.

[56] *Annual Review and Summary Financial Statement for the Year Ended 31 March 2003*, Vodafone Group Plc, Newbury, Berkshire, U.K., 2003, p. 1 (Hereafter cited as *Vodafone Financial Statement*.)

[57] *Vodafone Financial Statement*, p. 38.

[58] Vodafone owns 69.7%. See: *Vodafone Financial Statement*, p. 44.

[59] Press release, "J-PHONE Launches 3G Service Based on International Standards."

[60] *Vodafone Financial Statement*, pp. 6, 25.

[61] David Pringle, Devin J. Delaney, and Carita Vitzthum, "Europe's Telecoms Are Bringing in Cash – and Investors Want a Share," *The Wall Street Journal*, July 21, 2003, pp. A-1/2.

## Technology Immaturity

In Chapter One, we discussed why early technologies fail. There, we pointed to the similarities between the current despair over UMTS and that over GSM ten to 12 years before. In this section, we examine the early failures of UMTS handsets.[62] We document that the handsets are improving and show the impact of that on subscriber acceptance. We use the experience of NTT DoCoMo as an example.

Following a four-month "introductory phase," DoCoMo launched "fully commercial" UMTS service on October 1, 2001.[63] It deployed a Japanese variant of UMTS (called FOMA or sometimes J-UMTS) that is non-compliant with what was then, and remains, the evolving European standard.

Inadequate coverage and limited services aside, subscriber experiences with early UMTS handsets were not pleasant. Initially only one model each from NEC and Panasonic (Matsushita), plus a Panasonic PC card, were available. The handsets weighed 105 grams (3.7 oz.) and 150 grams (5.3 oz.), respectively. This was 50 to 120 percent more than Japanese 2G models that then weighed as little as 67 grams (2.4 oz.).[64] The handsets shut off spontaneously.[65] Dropped calls were pervasive. Batteries provided only one hour of talk time. Despite claimed standby of 55 hours, batteries lasted barely a day. Heavy data users found the handsets unserviceable, with batteries overheating and cutting out in as little as 15 minutes.[66]

As we have observed, such deficiencies are common to all new mobile technologies. Just as importantly, they are corrected over time. That is already happening.

In late January 2003, DoCoMo introduced two improved handset models with claimed standby times of 170 to 180 hours. Shortly afterwards, it introduced a third new model. These had a remarkable effect on subscriber growth. During January, prior to introduction of the new models, DoCoMo added 2,600 new subscribers to its FOMA (UMTS) service. In February, following introduction, it added 37,000.[67]

**Figure 3.1** traces the spurt in DoCoMo's subscribers sparked by the new handsets. During the 15 months from October 1, 2001 through December 31, 2002, DoCoMo attracted 152,000 UMTS subscribers, an average of 10,100 per month. Following introduction of the handsets, UMTS subscribers surged to 535,000 by June 30, 2003. This was a gain of 383,000 during the five months, February through June, or an average of 76,600 per month, more than seven times the previous rate of growth.

[62] UMTS infrastructure will also take time to mature. For example, Hutchison in Hong Kong is dissatisfied with Nokia UMTS base stations and is replacing them (but not core network) with base stations from NEC and Siemens. The maturation of infrastructure will continue as UMTS progresses from the present Release 99 through Releases 4 and 5. That said, historically, the bulk of maturation problems with mobile technologies has come from handsets, rather than radio base stations, due to the requirements for miniaturization and lower power output. See: "Nokia's Asian Angst" and "H3G Picks NEC/Siemens in HK," *unstrung.com*, July 14, 2003.

[63] "DoCoMo Offer Discount for 2G, 3G Phones," *Reuters*, September 29, 2001.

[64] Robert A. Guth, "DoCoMo Launches 3G Service; Industry Hopes for Recovery," *The Wall Street Journal*, October 1, 2001.

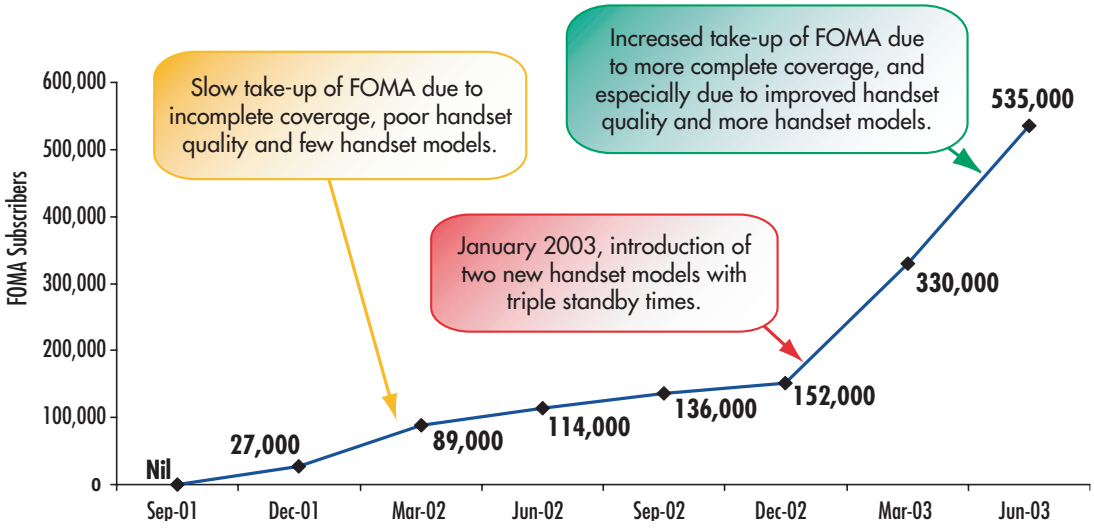
[65] Charles Bickers, "Mixed Signals on 3G Phones, " *Wireless Telecoms*, September 27, 2001.

[66] Frank Fisher, "DoCoMo Finds There's No Such Thing as a (Bug) Free Launch," *WapWeek*, October 2, 2001.

[67] "Japan's DoCoMo Posts Record 3G User Growth in Feb," *Reuters*, March 7, 2003 and "NTT DoCoMo Hits Lowered 3G User Target," *Reuters*, April 4, 2003.

FIGURE 3.1

**UMTS (FOMA) SUBSCRIBERS, NTT DOCOMO, OCTOBER 2001 TO PRESENT**




Sources: NTT DoCoMo, trade press reports, and interpolations by The Shosteck Group. DoCoMo officially launched UMTS on October 1, 2001.

In June 2003, DoCoMo introduced yet newer UMTS models from Fujitsu and NEC with claimed standby times of 200 to 240 hours.[68] We anticipate that these models – and yet more improved ones coming afterwards – will stimulate continued gains in UMTS subscribers.

Hutchison-U.K. and Hutchison-Italy are the only other major launches of UMTS to date. They, also, are experiencing handset problems.[69] Indeed, the competitors of Hutchison-U.K. maintain that its quality of service is so poor that they have no need to answer its lower tariffs with tariff reductions of their own.[70]

These handset problems may be more pervasive than those experienced by DoCoMo, due to the added complexity of handoff between UMTS and GSM-GPRS that is required of European UMTS. Nonetheless, they will be overcome. The quality of UMTS service is improving and will continue to do so. As we discuss in the next section, this may happen more quickly than Hutchison's competitors expect.

## DoCoMo's Technology Strategy

We surmise that DoCoMo's purpose in launching UMTS so early was, in part, to give Japanese handset vendors advanced experience with W-CDMA technology. This would enhance their competitive positions in Europe and serve DoCoMo in terms of the stronger products they could

[68] "DoCoMo to Offer Advanced 3G Phones to Boost Demand," *Reuters*, June 16, 2003.
[69] *ibid.*, and Chris Nuttall, "Hutchison 3G Mobile Price Cuts Represent a Tough Call for Rivals," *Financial Times*, June 16, 2003.
[70] *ibid.*, Nuttall.
[71] Ken Belson, "Trying to Attract Cell Users to Next Wireless Generation," *The New York Times*, October 10, 2001.

develop. DoCoMo also intended to provide advantage to its then partners – AT&T Wireless in the U.S., KPN Mobile in the Netherlands, and Hutchison in the U.K.[71] They would benefit from the handsets developed by the Japanese vendors and the experience with applications developed by DoCoMo.

DoCoMo's commitment to handset development extends beyond furnishing its vendors with real-world experience. In April 2003, DoCoMo made public an investment of $350 million (42 billion yen) in Sharp, NEC, Panasonic, Fujitsu, and Mitsubishi to develop UMTS handsets. Under that agreement, which extends from April 1, 2002 through March 31, 2004, the five vendors are developing handsets to support advanced applications while still providing long battery life. DoCoMo will share rights in patented technologies and receive royalties on handset sales to other operators. The explicit goal of this investment is to accelerate adoption of UMTS.[72]

While DoCoMo is supporting Japanese vendors, Korean vendors are relying on their own resources to position themselves for UMTS. We describe this in Chapter Five.

## Summary and Conclusions

This chapter examines two factors that have been thought of as impeding UMTS adoption – (1) financial constraints on the operators and (2) technology immaturity.

Most operators have slashed infrastructure expenses. Nonetheless, many hold strong cash positions and some continue to invest. Vodafone stands out. Its free cash flow more than doubled from £2,365 million in 2001-2002 to £5,171 million in 2002-2003. Over the same period, it raised its capital expenditures from £4,145 million to £5,289 million.

This reveals that some operators have the cash to build UMTS networks. It implies that other factors, in particular, immature technology, are more important in limiting investment.

NTT DoCoMo provides an example of the impact of technology maturity. DoCoMo launched UMTS in October 2001, deploying a Japanese variant (called FOMA or sometimes J-UMTS). The first handsets functioned poorly. In January 2003, DoCoMo launched improved handsets. Prior to then, it was drawing an average of 10,100 UMTS subscribers per month. Following, it drew an average of 76,600 per month.

DoCoMo launched UMTS early to give Japanese vendors experience with W-CDMA technology and, thereby, to benefit from their accelerated development of handsets. In April 2002, DoCoMo went a step further, investing $350 million in Sharp, NEC, Panasonic, Fujitsu, and Mitsubishi to support further development of handsets.

With earlier experience and DoCoMo's funding, Japanese vendors may bring improved UMTS handsets to Europe sooner than is commonly assumed. This will stimulate more rapid growth of UMTS subscribers than some may expect.

[72] "Sharp 3G FOMA Handset Investment," *3g.co.uk*, April 23, 2003.

# CHAPTER 4: THE INFLUENCE OF EDGE

## INTRODUCTION

EDGE has provided a recurrent drama for Western European operators. Initially, they considered it. Subsequently, it fell from favor. Since late 2002-early 2003, trade press reports reflect a reviving European interest, if not an absolute commitment.

In March 2003, Italy's Telecom Italia Mobile (TIM) announced plans to launch EDGE commercially. The press reported this as "the most visible indication that operators are reassessing the technology."[73] Nokia, who views EDGE as a strategic expansion of its infrastructure business, announced that "operators worldwide have started to roll out GSM/EDGE hardware" and promised that "EDGE will be available in all new Nokia GSM/GPRS terminals by end of 2004."[74] By May 2003, 3G Mobile, a respected trade publication, wrote that "Europe is on the verge of a breakout of EDGE services, with Telecom Italia Mobile and Pannon GSM [Hungary] among the key operators that could potentially launch commercial services this year."[75]

It remains uncertain of the extent to which European operators will actively deploy EDGE. As of July 31, only TIM had publicly committed to commercial deployment; Pannon had committed to a "trial." Orange (U.K.) was accepting "EDGE capable" equipment.[76] Possibly, there is a greater commitment to commercial deployment than public disclosures imply. The trade association, 3G Americas, suggests that operators may be withholding announcements of EDGE deployments for competitive reasons. Because of this, "vendors may have knowledge of the intended EDGE deployment by operators," but decline to divulge it.[77]

What may be a rekindled European interest in EDGE raises two questions. **First**, to what extent, if at all, might deployment of EDGE delay the launch of UMTS? **Second**, to what extent, if at all, will investment in EDGE reduce investment in UMTS? We examine these questions in this chapter.[78] To delve beyond the press reports, we surveyed the seven major European and North American vendors of wireless infrastructure as well as several major European operators.[79]

[73] Richard Handford, "TIM Takes the Lead with Move to EDGE for High-Speed Services," *Mobile Communications*, March 2003.

[74] Press release, "Thailand's First EDGE Trial Puts DTAC in the First Wave of Operators Globally Moving towards Advanced Mobile Services," Nokia, Richardson, Texas, April 3, 2003.

[75] "Major Operators Build Momentum Behind EDGE," *3G Mobile*, May 28, 2003, pp. 1-2.

[76] "EDGE Operators Worldwide – Status of Deployments at July 31st, 2003," Global Mobile Suppliers Association, July 31, 2003 (www.gsacom.com)

[77] Personal communication, Vicki Livingston, Director of Marketing, 3G Americas, Seattle, Washington, July 2, 2003.

[78] We do not consider whether vendors will deliver EDGE terminals as scheduled, whether EDGE will meet its performance promises and if so how quickly, or whether its full costs will prove as low as assumed. For a perspective on these questions other than our own, see Fanos Hira, Maurice Patrick, Paul Harper, and Jeremy Hudson, "The Uncompetitive EDGE?" *Wireless Network Economics*, Bear Stearns European Equity Research, London, July 3, 2003.

[79] The vendors were Alcatel, Ericsson, Lucent, Motorola, Nokia, Nortel, and Siemens. We received replies from the five largest vendors and two operators. We thank the analyst-relations personnel of those companies for their assistance.

## The Impact of EDGE on UMTS Deployment[80]

We asked two questions regarding the impact of EDGE on UMTS deployment – "What effect, if any, do you think the launch of EDGE will have on the launch of UMTS?" and "Do you think that the launch of EDGE will delay the launch of UMTS or likely not?"[81]

When asked directly, no vendor thought that the launch of EDGE would delay UMTS. One operator, with no near-term plans to deploy EDGE, thought that it might. Yet, that operator planned to launch UMTS during 2004, citing the immaturity of handsets as the most important factor affecting the launch date.

Replies to the more general question provided details of how respondents perceive the impact of EDGE. Most reiterated that EDGE would not affect the launch of UMTS. One thought that it might delay full build-out, but saw "less than a five percent to ten percent [negative] impact [on UMTS deployment]."

Surprising to us, two vendors anticipated that EDGE would have a positive effect on UMTS. One anticipated that EDGE would "promote new services" and, thereby, "play a role in pushing the [data] market." Another echoed that sentiment, stating that "EDGE will stimulate mobile data growth …[and] as a result, it will have a positive effect on W-CDMA."

A second theme put these views into perspective. Respondents characterized EDGE as a cost-effective "supplementary" or "complement" to UMTS in areas where UMTS would not be launched immediately. One vendor observed that UMTS licenses have not yet been granted in "about 50 percent of Western European [mostly smaller] countries." Another observed that EDGE would provide "cost-efficient high-speed coverage outside the major [high-traffic] areas." An operator supported this view, pointing out that "EDGE is for rural [areas] only," but added the caveat, only "if cheaper than … UMTS."

In sum, whatever impact EDGE may have, no vendor sees it as delaying the early launch of UMTS. Some see it as enhancing UMTS adoption. In general, respondents view EDGE as a supplement to UMTS, enabling operators to provide data services in lower traffic areas at less cost than would be possible with UMTS.

## The Impact of EDGE on UMTS Investment

Given the perceived financial constraints on operators that we discussed in Chapter Three, one might surmise that even if investment in EDGE did not delay the initial launch of UMTS, it would reduce the financing available for UMTS expansion. Respondents don't think so.

To explore this issue, we asked, "To what extent if at all, will operator investment in EDGE reduce their investment in UMTS?"

In reply, respondents reiterated the theme of EDGE enabling supplementary service at reduced costs. "Operators can reduce their spending … in low-medium [traffic] areas with the help of

[80] All quotations in the remainder of this chapter that we do not attribute are taken from the questionnaires. At the request of the companies, we do not cite them.

[81] We asked no questions regarding technology maturity. For purposes of this analysis, we assumed that vendors and operators would consider such issues in responding.

EDGE." Because "EDGE uses … GSM bands, including … 900 MHz, [it has an] inherent advantage in coverage … over … W-CDMA [at 1900/2100 MHz]."[82] For this reason, EDGE will not cause operators to "reduce their investment in UMTS, but [will] allow them to offer [supplementary] data services [over] a larger coverage area."

Respondents also observed that in some respects, drawing a dichotomy between UMTS and EDGE is misleading. Two pointed out that increasing numbers of base stations are being shipped as "EDGE-ready." These have the EDGE hardware in place and require only a software upgrade. One vendor stated that "about 50 percent of our upgrade shipments … for GSM is EDGE-ready … [requiring] just a software upgrade in the future." A second vendor supported this view, pointing out that the transition to "EDGE should happen organically through regular TRX upgrades [to GSM base stations]," while "UMTS will likely proceed independently."

From a different perspective – and corroborating our discussion in Chapter Two – another vendor noted that to meet regulatory mandates, operators would have to build UMTS networks, regardless of EDGE.

Overall, respondents see virtually no effect of EDGE on UMTS investment. This is at odds with the viewpoints attributed to "[financial] analysts," who if press reports are to be believed, anticipate that, "Investments in EDGE networks by Western European operators may further delay investment in … third generation (3G) networks."[83]

## Summary and Conclusions

This chapter examines two questions – the extent to which deployment of EDGE might delay the launch of UMTS and the extent to which investment in EDGE might reduce investment in UMTS. We gathered information through a questionnaire survey of major equipment vendors and, to a lesser extent, European operators.

When asked directly, no vendor thought that the launch of EDGE would delay UMTS. Indeed, two saw it as enhancing UMTS adoption by stimulating data services and providing such services cost-effectively in low traffic areas.

Nor did respondents see EDGE deployment leading to reduced spending on UMTS. They viewed the technologies as providing different functionality under different circumstances, UMTS for high-traffic areas and EDGE for lower-traffic areas. Two vendors pointed out that more and more GSM base stations are being shipped as "EDGE ready" and would require only software to add EDGE functionality. They viewed adoption of EDGE as evolving "organically" through the continuous process of base station upgrades. This points to eventual EDGE adoption, regardless of circumstances.

Overall, the extent to which EDGE may or may not be deployed will not affect the deployment of UMTS. If anything, a robust adoption of EDGE could stimulate the data market and, thereby, accelerate deployment of UMTS.

[82] Due to the nature of radio wave propagation, the lower frequency bands (800/900 MHz) cover larger areas than do the higher frequency bands (1800/1900/2100 MHz), given the same tower heights and signal strength (effective radiated power).

[83] Lucas van Grinsven, "Nokia Says Operators Want Walkie-Talkies and EDGE," *Reuters*, June 17, 2003.

# CHAPTER 5: HANDSETS AND THEIR IMPACT

## INTRODUCTION

Handsets acceptable to end-users are essential for the adoption of a new mobile technology. Acceptability encompasses, at least, three elements: (1) good performance, (2) a large number and variety of models, and (3) low prices. Shortcomings with any of these will inhibit adoption.[84]

We examine these elements in this chapter. On the one hand, we concluded that UMTS handsets will soon work reasonably well and that numerous models will quickly become available. These will encourage UMTS adoption. On the other hand, wholesale prices may decline at a relatively slow rate. If reflected at the retail level, it would inhibit adoption. However, high wholesale prices will be mitigated by operator subsidies.

As we pointed out in Chapter Two, PC Cards are already enabling laptops to access UMTS. That said, conventional handsets, because of their voice capabilities, are and will continue to be the primary means of UMTS access. For this reason, we focus on them.

## HANDSET PERFORMANCE

As we observed earlier, UMTS handsets have been plagued with technical disappointments. However, disappointments are common to all new technologies and are overcome as the technologies mature. We used NTT DoCoMo as an example. We tracked the sluggish growth of UMTS (FOMA) subscribers from October 2001 through January 2003, due to poorly performing handsets, and the spurt in growth from February 2003, driven by improved models.

Notwithstanding this progress, for two reasons, UMTS handsets for Europe will suffer greater technical difficulties. On the one hand, they need to hand-off between UMTS and GSM-GPRS. This has not been required of DoCoMo's handsets, which through May 2003 operated only on the FOMA (J-UMTS) network.[85] On the other hand, and in contrast to early GSM, the UMTS standard is not yet rigorously defined. This is leading to greater challenges in assuring interoperability between the handsets and infrastructure of different vendors, and to a more extensive period of "de-bugging."[86]

However, these concerns are counter-balanced by three circumstances that are unique to UMTS and that will accelerate its adoption.

**First**, as we have noted, because of DoCoMo's early launch, Japanese handset vendors have gained as much as an 18-month advantage in experience with a commercial UMTS network. **Second,** as we documented in Chapter Three, DoCoMo is providing $350 million to Japanese vendors to develop handsets. **Third**, Korean vendors are viewing UMTS as a means of expanding their share of the European market.

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[84] Handsets which are encumbered by a less than adequate network will inhibit adoption as well.

[85] However, on June 11, DoCoMo deployed the FOMA N2701, its first dual-mode PDC/J-UMTS handset. See: "DoCoMo Intros Dualmode Phone," *unstrung.com*, May 27, 2003.

[86] Pietro Porzio Giusto, Vice President, Value Added Services/UMTS, Telecom Italia Mobile, "Building a Successful Transition to 3G"; *2003 Oxford in Tuscany: Realistic Visions of the Wireless Future – Market and Business Profit Opportunities to 2007*; The Shosteck Group, Green Park Resort, Tirrenia, Italy, June 26, 2003.

Korea's vendors have experience with the 1.25MHz channels of cdmaOne and CDMA 2000. The RF characteristics of the 1.25 MHz channels are not fully comparable to those of the 5 MHz channels of W-CDMA, the RF technology of the UMTS standard. Nonetheless, the similarity provides the Koreans with an advantage. Samsung and LG, the leading Korean vendors, now rank third and fifth (or sixth) in terms of handsets shipped. During 2002, they shipped 42 million and 16 million, respectively, and are shipping yet greater volumes during 2003.[87] These sales are providing them with the resources to support UMTS development. In March 2003, Samsung announced the SGH-Z100, a fully featured GSM-GPRS/UMTS model intended for the European market.[88] Early in 2003, LG Electronics announced plans to enter that market as well.[89]

The competitive resurgence of the Japanese and the participation of the Koreans assure faster advances in UMTS technology and a greater variety of handsets than otherwise would be the case. Indeed, the greater experience of Japanese vendors and DoCoMo's funding may enable them to produce handsets that are superior to those of Nokia and Motorola.

That said, Motorola (and we assume Nokia) acknowledge no such disadvantage. Motorola has quantified handset functionality in terms of size, weight, and talk/standby times. It describes these characteristics as "fundamentals [that]drive [UMTS] growth." It foresees that handsets, whether GSM-GPRS or GSM-GPRS-UMTS, will be equivalent for all three of these characteristics by year-end 2005, if not sooner.[90]

## The Number and Variety of Handset Models

End-users will compare the models that support a new technology with those that support an old one. For this reason, a large number of varied handset models is essential for the rapid adoption of a new technology.

**Figure 5.1** quantifies the number of new UMTS models introduced and the number of manufacturers producing them for 2001 and 2002 and our estimates for 2003. These include models for the DoCoMo and conventional UMTS networks. As we discussed earlier, DoCoMo's handsets cannot operate on European networks and vice-versa. However, the two technologies are close enough to enable Japanese vendors to produce to the European standard.

We have based the model and manufacturer counts for 2001 and 2002 on our previous analyses.[91] We have estimated counts for 2003 from press reports and replies to our vendor survey, key parts of which we analyzed in Chapter Four. The counts of models exclude PDAs and PC cards.

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[87] "Terminal Sales by Manufacturer, World Market, 1997-2003 (b_8)," *Shosteck E-STATS*, The Shosteck Group, Wheaton, Maryland, continuous.

[88] Press release, "Samsung Electronics Demonstrates Real 3G Service at CeBIT 2003," Samsung Electronics, Hanover, March 13, 2003 (www.samsung.com/PressCenter/PressRelease/Telecom...)

[89] Press release, "World's First DBDM Phone for both CDMA and W-CDMA Developed by LG Electronics," Seoul, Korea, February 10, 2003 (www.lge.com/about/news/news_read.jsp?seq...); Press release, "LG Electronics Ranks 5th on the Global Mobile Phone Market," Seoul, Korea, May 23, 2003 (www.lge.com/about/news/news_read.jsp?seq...); and "LG's 3G Aspirations," *www.3G.co.uk*, July 3, 2003.

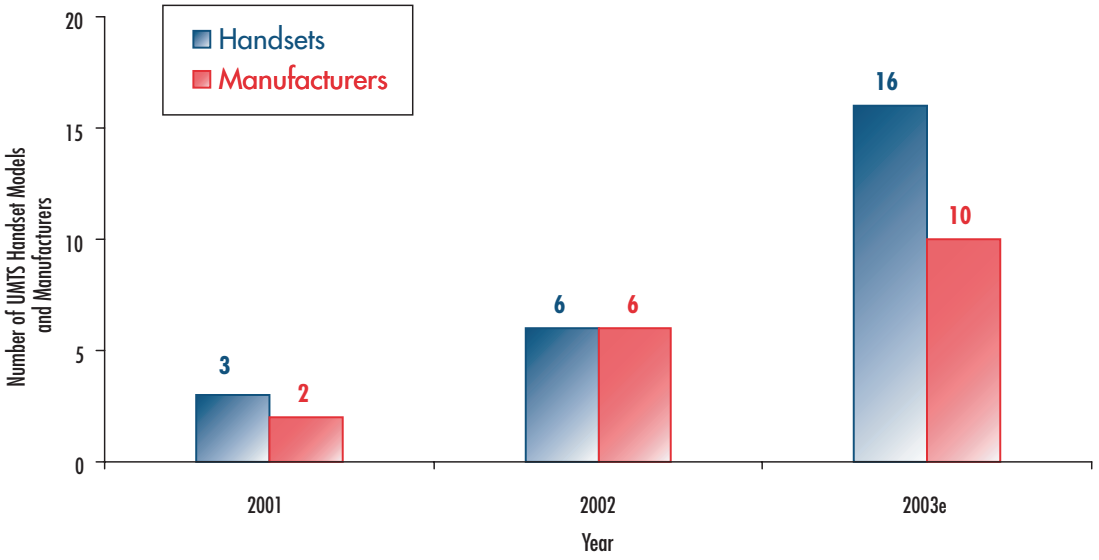
[90] Ron Garriques, Senior Vice President and General Manager; Europe, Middle-East, and Africa; Personal Communications Sector; Motorola, Inc.; "Fundamentals Drive 3G Growth (WCDMA v. GSM; Index GSM 100%)," *Motorola Analyst Meeting 2003*, Westin O'Hare Hotel, Rosemont, Illinois, July 28-29, 2003.

[91] These were derived from the *EMC World Cellular Database* www.emc-database.com.

These values show rapid increases in the launches of UMTS models and the vendors manufacturing them. During 2001, two vendors launched three models. During 2002, six vendors launched six models. During 2003, we estimate that ten vendors will launch 16 models, although one survey respondent anticipates 20. We foresee that vendors will introduce 30 to 40 new UMTS models during 2004. Most of these models will come from re-emergent Japanese vendors, in particular, NEC, Panasonic (Matsushita), Fujitsu, Sharp, and Mitsubishi – the five that DoCoMo is supporting – and possibly Sanyo. This will place enormous competitive pressures on Nokia, Motorola, Siemens, and Sony-Ericsson. Such competition will stimulate output of yet more models, with improved functionality, which in turn will drive adoption of UMTS.

FIGURE 5.1

**THE INTRODUCTION OF UMTS HANDSET MODELS AND MANUFACTURERS, WORLD MARKET, 2001 – 2003**




Source: Counts for 2001 and 2002 from *EMC World Cellular Database*. Estimates for 2003 by The Shosteck Group. Includes Japanese W-CDMA (branded as FOMA) which, at present, is not compliant with the European UMTS standard. Excludes PDAs and PC cards.

## Handset Prices

No matter how good the functionality or how numerous the models, handsets must be priced to draw end-users. In the U.S. and most of Europe, operators historically have subsidized handsets. Subsidies may stimulate more rapid adoption of a service or technology.[92] However, operators must account for subsidies in estimating cash flow and profits. If a subsidy is too great, an operator may attract subscribers, each of which contributes to loss.[93]

[92] However, this is unclear. Handset subsidies are illegal in Finland and, by convention, are not used in Italy. Both of these countries have among Europe's highest rates of cellular adoption.

[93] We address this issue in our study, *AMPU (Average Margin per User) – Not ARPU (Average Revenue per User): A Better Metric for the Wireless Industry*, The Shosteck Group, Wheaton, Maryland, May 2003, p. 60. This includes a spreadsheet model in Excel that enables those purchasing the study to estimate the profit (or loss) that a specific application, product, or service will likely generate. To illustrate the model, the study uses adoption of UMTS services, including handset subsidies.

Having said that, we anticipate that network operators will subsidize UMTS handsets to $100 or less. This is being driven by Hutchison-U.K., which is already selling handsets for as little £49 ($80).[94] This compares with what we estimate were initial wholesale costs to operators of $600 to $800 and, as of July 2003, wholesale costs of $400 to $600, with the average centering at $450 to $500.[95]

One can argue that such subsidies will drive the company to bankruptcy. However, as we concluded in Chapter 2, Hutchison recognizes that over the mid- to long-terms, UMTS will enable it to provide lower-cost voice service. As such, it believes that it can offer voice to heavy users at as much as 50 to 70 percent below current rates and still prosper. If it attracts enough such users from other operators, the handset subsidies – in the abstract – make sense.

Whether or not Hutchison has the financing to reach breakeven is another matter. Nonetheless, by subsidizing UMTS handsets to less than $100, it has opened a pricing war from which likely there will be no return. As such, the price of handsets as a barrier to adoption of UMTS, at least for heavy users, will no longer be an issue.

As we pointed out in Chapter Two, the competition from Hutchison aside, operators may find that subsidizing UMTS handsets for their heaviest users will be a less expensive way to relieve capacity on their GSM-GPRS networks than by adding GSM-GPRS infrastructure. As a further benefit, as operators shift traffic from GSM-GPRS to UMTS, interference on the GSM-GPRS networks will decline and the Quality of Service improve.

## Summary and Conclusions

For end-users to adopt UMTS, handsets must be acceptable. Acceptability encompasses: (1) good performance, (2) a large number and variety of models, and (3) low, or acceptable, prices to end-users. Shortcomings with any of these will inhibit adoption.

Driven by competition among Japanese, Korean, European, and North American vendors, UMTS handsets will soon work reasonably well, and numerous models are quickly becoming available. We anticipate introduction of 16 to 20 models during 2003 and twice that during 2004. Improving handset functionality and the proliferation of choice will encourage UMTS adoption.

Initially, Japanese vendors will lead the market in terms of handset functionality and number of models. This will stem from their early experience with the DoCoMo network and the $350 million that DoCoMo has invested in them.

While current wholesale prices average from $450 to $500, Hutchison-U.K is subsidizing handsets to under $100. Hutchison has likely opened a permanent pricing war. Operators will offer UMTS handsets to heavy users at less than $100. Because of this, handset prices will not pose a critical barrier to UMTS adoption.

[94] "New 3G Handset for Hutchison 3G," *www.3G.co.uk*, July 7, 2003.

[95] These estimates are based on reports by informed industry sources.

# CHAPTER 6: FORECASTING THE ADOPTION OF UMTS

## INTRODUCTION

Our previous chapters described and analyzed the factors we consider most important for advancing or impeding UMTS adoption. The former include regulatory mandates, greater capacity, and – over the mid- to long-terms – lower capital and operating costs. The latter include financial constraints on operators – which we revealed are likely not real – and technology immaturity. Separate chapters discussed the role of EDGE and the impact of handset functionality, availability, and pricing. We concluded that most factors are driving UMTS forward and will assure its deployment and adoption.

Thus, the key question becomes not whether UMTS will be deployed, but how quickly. This chapter examines the rate of adoption from two perspectives, the annual increase in subscribers and annual handset sales.

We have derived these forecasts from two sources – our expectation of UMTS adoption based on the earlier transition from analog to digital and the projections provided by respondents to our vendor survey.

## FORECASTING UMTS SUBSCRIBERS

We have used the transition from analog to digital to forecast the transition from GSM to UMTS. We have chosen the U.S. digital transition, rather than that of Europe, because the U.S. is more comparable to what we foresee will be the transition to UMTS. The U.S. and European digital transitions differed in three broad respects.

**First**, at the beginning of the digital transition, analog service in Europe (primarily TACS) was less available than was analog service in the U.S. (AMPS).[96] This meant that relatively more investment had been made in U.S. analog. On this account, U.S. operators were more reluctant to abandon analog.

**Second**, many, if not all, European regulators mandated closure of analog networks. This accelerated deployment of digital and spurred operators to transfer subscribers to it. U.S. regulators imposed no such mandates. This left U.S. digital adoption to longer-term market forces.

**Third**, the European transition was based on entirely new and separate GSM networks. Only single-mode GSM handsets were available. This forced a rapid build-out of GSM networks to provide wide-area coverage. In contrast, the U.S. digital transition was based on TDMA and CDMA "overlays" onto AMPS networks.[97] For the original cellular networks, digital access was (and is) provided by dual-mode AMPS-TDMA or AMPS-CDMA handsets.[98] This allowed slow

[96] Among the four most populous countries of Europe, only the U.K. and Italy had relatively available and inexpensive TACS service. Germany and France had only proprietary analog networks with limited capacity and exceptionally expensive mobile handsets. The Nordic countries deployed the NMT standard. However, together they had but 40 percent the population of any one of the four most populous countries.

[97] This was true of Canada, as well as other countries that deployed AMPS systems.

[98] This has been and remains the case for legacy 850 MHz "cellular" networks, but not necessarily for more recently constructed 1900 MHz "PCS" networks.

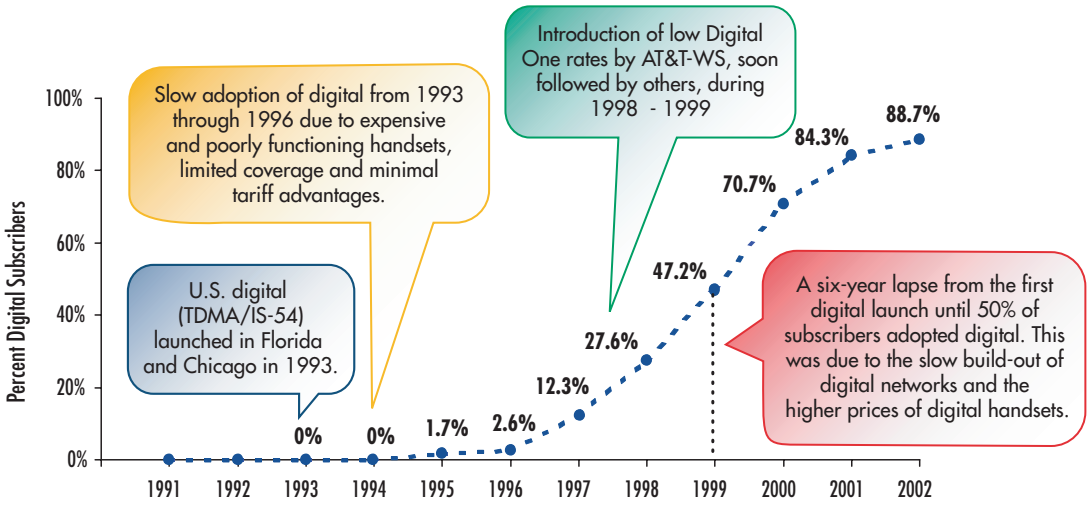
build-out of digital networks, in that digital subscribers could be served by analog outside of digital coverage areas. Because of such differences, the U.S. transition to digital took longer than did the transition in Europe.[99]

The transition to UMTS will be more like the digital transition in the U.S. than in Europe. Today in Europe, there is a vast base of GSM infrastructure. No regulations mandate the closing of GSM networks. UMTS requires dual-mode GSM-GPRS-UMTS handsets that enable roaming onto GSM-GPRS networks. This reduces the need for rapid UMTS coverage. For these reasons, the European transition to UMTS will take longer than did the European transition to GSM.

**Figure 6.1** graphs the still incomplete U.S. digital transition, as measured by percent of subscribers. It documents a slow initial take-up. In addition to issues of technology maturation, this was due to the fragmented deployment of U.S. digital, which was launched over time on a market-by-market (urban area) basis. In a not dissimilar fashion, European UMTS is *de facto* being launched on a country-by-country basis.

FIGURE 6.1

**DIGITAL ADOPTION CURVE, SUBSCRIBERS, U.S. MARKET, 1993 – 2002**




Source: CTIA and derivations by The Shosteck Group. Values as of year-end.

Commercial digital service (TDMA IS-54, the predecessor to current TDMA IS-136) was first launched by McCaw Cellular (now AT&T Wireless Services) in Florida in March 1993 and Southwestern Bell Mobile Systems (Cellular One) in Chicago in July.[100] By year-end 1994, only 100,000 U.S. subscribers out of 24.1 million, or 0.4 percent, had adopted digital. By year-end 1995, 600,000 subscribers out of 33.8 million, or 1.7 percent, had adopted it.

[99] The U.S. digital transition is not yet fully complete. Today, about 90% of U.S. subscribers use digital. In Europe the figure is virtually 100%.

[100] "Southwestern Bell Mobile Systems Starts Massive TDMA Trial in Chicago," *Telocator Bulletin*, Personal Communications Industry Association, Washington DC, July 26, 1993, p. 8, and "Southwestern Bell Mobile Systems Begins Commercial Digital Service in Chicago …," *Telocator Bulletin*, July 30, 1993, p. 8. These were not the first launches of TDMA (IS-54). The Canadian operators AGT Cellular and Cantel Cellular announced commercial service in Calgary, Alberta and Toronto, Ontario in July 1992.

AirTouch Cellular (now part of Verizon) overlaid CDMA (IS-95) onto its 850 MHz AMPS network in Los Angeles in May 1996, offering commercial service to selected heavy users.[101] In August 1996, 360° Communications (now part of Sprint) launched CDMA at 1900 MHz in Las Vegas, Nevada.[102] By year-end 1996, 1.1 million subscribers, or 2.6 percent, had adopted either TDMA or CDMA. Almost four years after launch, digital adoption remained inconsequential.

Only during 1997, did the number of digital subscribers escalate. That year saw an increase to 6.8 million out of 55.3 million, or 12.3 percent. This increase was primarily due to the launch of all-digital Personal Communications Services (PCS) at 1900 MHz.[103] These launches began in 1995 and accelerated in 1996. With them, cellular operators at 850 MHz extended their digital efforts. With increased competition, digital tariffs declined.[104]

The most dramatic decline occurred in 1998. In May, AT&T Wireless Services introduced its then revolutionary "AT&T Digital One Rate." This cut tariffs by virtually one-half. Concurrently, it eliminated separate roaming and long distance charges, *de facto*, a further tariff reduction.[105] Within a year, all other major operators had followed. As a consequence, during 1998, the proportion of digital subscribers more than doubled from 12.3 percent to 27.6 percent. By year-end 1999, they virtually doubled again to 47.2 percent.[106]

In sum, it took about seven years from initial commercial launch for digital to draw one-half of the U.S. subscriber base. Only in the last of these years did we see meaningful growth. As measured by subscriber growth and handset sales, we anticipate a similar slow initial adoption of UMTS, albeit not as prolonged.

However, parallel to the case with digital, UMTS traffic will increase more rapidly. Operators will begin the transition by encouraging their highest-use GSM-GPRS subscribers to move to UMTS or, in the case of Hutchison, to churn from other networks.

This migration strategy offers operators four advantages. **First**, it maximizes voice loading on the UMTS network. This quickly expands the revenue available for depreciation. **Second**, it off-loads maximum traffic from the GSM-GPRS network. This increases Quality of GSM-GPRS Service. As such, it quickly reduces the need for further investment in GSM-GPRS capacity (but not coverage). **Third**, it minimizes the cost for subsidizing UMTS handsets, as measured by the revenue that each handset produces. A $400 subsidy for a subscriber who generates $100 or more per month is more

[101] "AirTouch Begins Limited Deployment CDMA in Los Angeles – Only Top-Tier Customers to Be Offered Service," *The [PCIA] Bulletin*, May 17, 1996, pp. 3-4. In common with TDMA, these CDMA (IS-95) networks were not the first. The technology was launched earlier in Hong Kong and Korea.

[102] "360° Communications Makes CDMA Cellular Service Available to All Its Customers in Las Vegas," *The [PCIA] Bulletin*, August 9, 1996, p. 4.

[103] PCS is equivalent to European "Personal Communications Networks" (PCN), which are licensed at 1800 MHz.

[104] With the exception of Sprint PCS in Washington-Baltimore, the launch of PCS in the largest U.S. markets took place between Q1-1996 and Q4-1998. For a record of the launches, see: "Perceived Quality of 800 MHz Cellular, 1900 MHz PCS, and 800 MHz E-SMR Reception, by Carrier, Ten Major U.S. Markets, Recent Quarters (u_3)" *Shosteck E-STATS*, The Shosteck Group, Wheaton, Maryland, continuous. For a record of tariff declines, see: "The Average Monthly Minutes of Local Use, Ten Major U.S. Markets, 1985-1997," *Shosteck E-STATS*.

[105] Press release, "AT&T Launches First National One-Rate Wireless Service Plan," AT&T, New York, May 7, 1998 and Kristen Beckman, "No Roaming Charges is Key to AT&T's One-Rate Calling Plan," *RCR*, May 11, 1998, p. 2.

[106] "Almost 89 Percent of Reported Subscribers Are Now Digital," *Semi-Annual Wireless Industry Survey*, CTIA, Washington, DC, December 2002 and derivations by The Shosteck Group.

palatable than the same subsidy for a subscriber who generates $50 or less. **Fourth**, it can minimize early marketing costs. Legacy operators, albeit not Hutchison, can encourage their own high-end subscribers to adopt UMTS through relatively low-cost direct mail and in-bound telemarketing.

The primary disadvantage in moving high-use subscribers to UMTS centers on timing. If neither the UMTS network nor handsets are sufficiently mature, the transition to UMTS may alienate an operator's best customers.

Limited network coverage and poorly functioning handsets, in particular, will constrain initial end-user acceptance of UMTS. However, as we pointed out in Chapter Three, DoCoMo is subsidizing vendors to develop handsets. This will lead to well-working models more quickly than otherwise would be the case. As important, if not more so, Hutchison-U.K., through its handset subsidies and aggressive rate plans, is assuring that expensive handsets and, especially, high tariffs will not impede UMTS adoption.

Because of Hutchison's early tariff reductions, we foresee a more rapid **initial** take-up of UMTS than was the case for U.S. digital. However, limited network coverage and, especially, immature handsets will still slow subscriber growth until the end of 2004 or early 2005.

**Figure 6.2** estimates the range of subscriber growth. The lesser values are based on our discussion above. The greater values are the highest estimates reported in our vendor survey.

FIGURE 6.2

**UMTS SUBSCRIBERS, WORLD MARKET, 2001 – 2007 (MILLIONS)**

| Year | Annual Increase | Total Subscribers |
|---|---|---|
| 2001 | nil | nil |
| 2002 | nil | nil |
| 2003 | 2 – 3 | 2 – 3 |
| 2004 | 5 – 12 | 7 – 15 |
| 2005 | 18 – 25 | 25 – 40 |
| 2006 | 30 – 40 | 55 – 80 |
| 2007 | 70 – 70 | 125 – 150 |

Source: The Shosteck Group. Values as of year-end. NTT DoCoMo launched the Japanese variant of UMTS on October 1, 2001. As of year-end 2001, it reported 27,000 subscribers. As of year-end 2002, it reported 152,000 subscribers. The lesser values are from The Shosteck Group, as discussed in text. The greater values are the highest estimates from our vendor survey. Both sources estimate a 70 million subscriber increase during 2007.

By year-end 2003, we anticipate two to three million UMTS subscribers (including Japan). During 2004, we anticipate an increase of five to 12 million subscribers, to a total of seven to 15 million. During 2005, we foresee growth of 18 to 25 million, to a total of 25 to 40 million. During 2006, we expect a gain of 30 to 40 million, bringing the total to 55 to 80 million. During 2007, we estimate 70 million new subscribers, bringing the global total to 125 to 150 million.

## Forecasting UMTS Handset Sales

We have derived handset sales from the estimates of UMTS subscribers. We have based the derivations on two factors. On the one hand are the handsets needed to serve new subscribers. On the other hand are the replacement handsets needed to replace obsolete, broken, lost, or stolen units from the established subscriber base.

Because of replacement, annual sales of handsets will exceed annual subscriber growth. Initially, the difference will be minor. During the early years, only a small base of UMTS subscribers will be available to purchase replacements. As that base grows, replacements will become more important.

**Figure 6.3** estimates sales of UMTS handsets from 2003 through 2007. During 2003, we assume negligible replacement. Thus, handset sales will equal the two to three million new UMTS subscribers. During 2004, we anticipate that one million out of the two to three million embedded subscribers will upgrade. Added to the five to 12 million subscriber increase, we estimate sales of six to 13 million. During 2005, we assume that the remaining one or two million who purchased UMTS handsets during 2003 will replace them, while three to four million who purchased during 2004 will do so. This sums to five million replacement sales. Added to the 18 to 25 million new subscribers, we foresee UMTS sales of 23 to 30 million. Using similar replacement assumptions, we estimate sales of 35 to 50 million handsets during 2006 and 70 to 85 million during 2007.

FIGURE 6.3

**UMTS HANDSET SALES, WORLD MARKET, 2001 – 2007 (MILLIONS)**

| Year | Unit Shipments |
|---|---|
| 2001 | nil |
| 2002 | nil |
| 2003 | 2 – 3 |
| 2004 | 6 – 13 |
| 2005 | 23 – 30 |
| 2006 | 35 – 50 |
| 2007 | 70 – 85 |

Source: The Shosteck Group. Manufacturers shipped approximately 300,000 units during 2002.

Our estimates of handset sales from 2003 through 2007 tend to range above those of Deutsche Bank Securities, which estimates 500,000; 2,900,000; 16 million; 38 million; and 65 million, respectively.[107] The major difference centers on the bank's lower expectations for 2003 through 2005. It foresees issues of interoperability being more severe than do we. Beyond 2005, its expectations are close to the lower range of our own.[108]

[107] "Figure 3: Handset Unit Forecasts," *Signals to Noise (S2N)*, Deutsche Bank Securities, Inc., New York, continuous. These include J-UMTS.

[108] Brian T. Modoff, Michael W. Thalander, and Daniel D. Kaplan, *The Rise of the 3G Empire*, Deutsche Bank, New York, June 17, 2003 and personal communication, Brian T. Modoff, Deutsche Bank, New York, July 21, 2003.

## Summary and Conclusions

The question is not whether UMTS will be deployed, but how quickly. Because of Hutchison's tariff reductions of 50 percent or more, we foresee a more rapid take-up of UMTS than would otherwise be the case.

We forecast UMTS subscriber increases and handset sales from 2003 through 2007. We derived our forecasts from an analysis of the transition from analog to digital and estimates reported in our survey of major UMTS vendors.

By year-end 2003, we anticipate two to three million subscribers. During 2004, we expect an increase of five to12 million, to a total of seven to 15 million. During 2005, we foresee growth of 18-25 million, to a total of 25-40 million. During 2006, we expect gains of 30-40 million, to a total of 55-80 million. During 2007, we estimate 70 million new subscribers, bringing the total to 125-150 million.

Handset sales have two components – sales to new subscribers and replacements. During 2003, we assume nil replacement. Handset sales will equal the two-three million new subscribers. During 2004, we anticipate one million replacements. Added to five to 12 million new subscribers, handset sales will reach six to 13 million. During 2005, we assume five million replacements. Added to 18-25 million new subscribers, handset sales will total 23-30 million. Using similar assumptions, we estimate a total of 35-50 million handset sales during 2006 and 70-85 million during 2007.